[588.1004]

COMPRESSOR

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of International Patent Application No. PCT/DE02/01814, filed May 21, 2002 and claims priority to German Patent Application Nos. 101 25 267.6 and 101 25 266.8 filed May 23, 2001, all three applications hereby being incorporated by reference herein.

BACKGROUND INFORMATION

[0002] The present invention relates to a compressor, in particular for air conditioning systems in motor vehicles, having a housing and a housing sealing cover, a drive shaft including bearings, a drive mechanism for pistons which move back and forth and convert the rotational movement of the drive shaft into a reciprocating movement of the pistons, a cylinder block in which the reciprocating pistons aspirate and compress a coolant, a valve device such as a valve plate having intake and discharge valves, and a cylinder head having intake and discharge chambers for a suction pressure zone and a discharge pressure zone.

[0003] Such compressors are known. In the related art, usually the component of the cylinder head that contains the intake and discharge chambers of the compressor is used as a housing sealing cover. Such a cylinder head may be joined to the housing using separate screws or by a single set of threads, as described, for example in German Utility Model 20013202 U1. The problem with this is that a hot part, i.e., the discharge chambers, and a somewhat cooler part, i.e., the intake chambers, are located in a cylinder head of this type, which results in varying thermal stresses in a cylinder head of this type, which is also negatively reflected in the quality of the screw connections or threaded connections between the housing and the cylinder head as well as in the quality of the sealing functions between the housing and cylinder head and between the cylinder head and valve plate.

BRIEF SUMMARY OF THE INVENTION

[0004] An object of the present invention is therefore to devise a compressor that does not have these disadvantages.

[0005] The object may be achieved by a compressor, in particular for air conditioning systems in motor vehicles, having a housing and a housing sealing cover, a drive shaft including bearings, a drive mechanism for pistons that move back and forth which convert the rotational movement of the drive shaft into a reciprocating movement of the pistons, a cylinder block in which the reciprocating pistons aspirate and compress a coolant, a valve device such as a valve plate having intake and discharge valves, intake and discharge chambers for a suction pressure zone and a discharge pressure zone, whereby on the one hand a cylinder head having the intake and discharge chambers and on the other hand a housing pot or housing cover or a sealing plate of the housing are designed as separate components. A compressor is preferred in which the housing pot or housing cover or the sealing plate, as well as, for example, the housing, are manufactured from steel or comparable materials, while the cylinder head is manufactured from an aluminum material.

[0006] A compressor according to the present invention is characterized in that the housing is essentially designed as a thin-walled tube and the housing cover as a sheet metal plate or a sheet metal pot, which may have thicker walls. According to the present invention, the sealing plate of the compressor or the bottom of the housing cover is elastically deformable, and the sealing plate or the bottom of the housing cover is designed in one area in such a way that a contact force acts on the cylinder head and clamps the cylinder head between the sealing plate or the housing cover and the valve plate. In particular, the cylinder head may be designed as an insert between the valve plate and the sealing plate or the housing cover.

[0007] Another compressor according to the present invention is characterized in that the sealing plate is pressed or screwed against the tubular housing using a

threaded ring. Another embodiment of a compressor has the housing sealing cover designed as a pot-shaped sheet steel part having internal threads.

[0008] In addition, a compressor is preferred in which the cylinder head has circumferential sealing webs, which are pressed against the valve plate by the elastic sealing plate or the elastic housing cover bottom.

[0009] Furthermore, a compressor is preferred in which the pressure conduits of the solenoid valves are welded to the housing cover or the closing plate.

[0010] In addition, a compressor is preferred in which the housing cover or the sealing plate has mounting devices such as eyes or lugs or tabs. Preferably the mounting devices may also be used to screw the housing sealing cover to the housing tube by making it possible to apply screw-in torque during assembly.

[0011] In a compressor according to the present invention, the threads between the threaded ring or the bottom edge of the housing cover and the housing tube part do not apply high stresses to the thicker closing cover or to the cover bottom in the transition to the thin tubular housing.

[0012] Another compressor according to the present invention is characterized in that the mounting devices such as eyes, lugs or tabs are produced during the forging or extrusion.

[0013] The objective may further be achieved by a compressor, in particular for air conditioning systems in motor vehicles, having a pot-shaped housing and a housing sealing cover, so that the entire housing area is essentially made of two pieces, a drive shaft including bearings, a drive mechanism for pistons that move back and forth and convert the rotational movement of the drive shaft into a reciprocating movement of the pistons, a cylinder block in which the reciprocating pistons aspirate and compress coolants, a valve device such as a valve plate having

intake and discharge valves, intake and discharge chambers for a suction side and a discharge side, the intake and discharge chambers, the intake and discharge valve device and the cylinder block being situated in the closed side of the housing, i.e., in the housing bottom. Preferably, the housing of the compressor is closed to the outside in the area of the cylinder block and valve plate and has no housing division in this area and accordingly no sealing device to the outside necessitated by it.

[0014] In addition, a compressor is preferred in which the housing cover and the sealing of the compression chamber are situated toward the outside, i.e., toward the environment on the side of the compressor opposite the greatest heat source of the compressor, i.e., the high pressure side.

[0015] This has the advantage that high temperatures and/or high pressures on the hot side of the compressor are not able to result in a failure of the gasket or of the fastening elements on the outside.

[0016] Another compressor according to the present invention is characterized in that the sealing of the compression chamber to the outside is accomplished by a gasket between the pot-shaped housing and the housing cover.

[0017] A compressor is preferred in which the housing/housing cover sealing devices such as threads or ring nuts or screws or flanged joints or welds, etc. are situated on the side of the compressor opposite the greatest heat source.

[0018] Furthermore, a compressor is preferred in which the shaft lead-through to the outside, the shaft bearings, and the shaft gaskets are situated in the area of the housing cover.

[0019] A compressor according to the present invention has a spacer between the suction pressure zone and the discharge pressure zone and, if necessary, a second spacer between the discharge pressure zone and the compression chamber pressure

zone, which separate the pressure zones and support the cylinder block and the valve plate against the housing bottom.

[0020] Also preferred is a compressor design in which the first spacer and the second spacer, if present, are integrated in the housing bottom.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The present invention will now be described with reference to the figures.

[0022] Figure 1 shows a compressor according to the present invention having one closing plate.

[0023] Figures 2.1 and 2.2 show detailed views of the gaskets.

[0024] Figure 3 shows the compressor of the present invention in perspective.

[0025] Figure 4 shows another compressor of the present invention having a pot-shaped housing cover.

[0026] Figures 5.1 and 5.2 show sealing systems on this compressor in detail.

[0027] Figure 6 shows another compressor of the present invention.

DETAILED DESCRIPTION

[0028] A compressor housing according to the present invention is shown in cross-section in Figure 1. The compressor housing is made up of a housing bottom 1, a housing tube 2, a cylinder block 3, a cylinder head 4, two O-ring gaskets 5 and 8, a housing sealing plate 6, housing threaded ring 7, two valve pressure conduits 9, and one gasket 10 on housing bottom 1. The drive mechanism parts accommodated in the housing include a shaft, pivot plate, and pistons. Also worth mentioning is a bearing bushing 11 which is situated in housing bottom 1 and may accommodate radial

bearings and, if necessary, axial bearings of the shaft. At locations 12 and 12b, the housing is provided with threads (external or internal threads) to make the transition of thicker sealing plate 6 to tubular housing 2 to be of low stress. In addition, this division makes it possible to provide housing bottom 1 with ears 27 (see Figure 3) for mounting during forging or extrusion and to weld pressure conduits 9 and mounting devices 13 to housing sealing plate 6 or cover 30 (Figure 4) for mounting. If a cover 30 (Figure 4) is used, the necessary screw-in torque may be applied in these ears (denoted as Number 13 and 27 in Figure 3) during mounting. The separation via threads 12 and 12b makes it possible to design tubular housing 2 with thinner walls in order to save weight. Cylinder block 3 may be provided with a gasket 5, an O-ring for example, in order to seal off suction chamber pressure zone 14 from the pressure zone in drive area 15. On its cylinder block side, cylinder head 4 has only two circumferential webs 16 and 18, which separate high pressure zone 19, suction chamber pressure zone 14 and drive area pressure zone 20 from each other. The cylinder head contains channels that supply two control valves and one pressure limiting valve. A pressure limiting valve is situated in cylinder head 4. Pressure conduits 9 of the control valves are welded to sealing plate 6 (laser welding, resistance welding). Sealing plate 6 is sufficiently elastic to absorb the thermal expansion of cylinder head 4. The force stored in it is primarily transferred via area 21. The position of area 21 is selected in such a way that it applies the accumulated force via sealing webs 22, and distributes the force to the two webs 16 and 18 of cylinder head 4 so that a slight deformation or compression of the cylinder head 4 causes a sealing effect. Sealing plate 6 may be held by a threaded ring 7 or be fixedly connected in the form of a cover via threads as shown in Figure 4, resulting in a pot-shaped cover 30.

[0029] According to the present invention, this system provides the following advantages: High thermal stresses are avoided. The previously very high screw-in torque is reduced. High stresses caused by otherwise necessary steps between the sealing surfaces in cylinder head 4 to produce an initial tension to form a seal between the cylinder head and the valve plate are significantly reduced. It is possible

to reduce the number of screwed connections from four to two by accommodating control valves 9, a pressure limiting valve and, if necessary, an oil separator in the cylinder head. Control valves 9 may be installed externally in a cost-effective manner while saving on gaskets. The housing gasket is made more reliable. The housing shell may be made completely from non-cast materials. This reduces the necessary test pressures.

[0030] Figures 2.1 and 2.2 show the seal on the housing bottom and on the housing cover in two detailed views. The seal on the housing cover, i.e., on sealing plate 6, ring nut 7, and tubular housing 2 is shown in Figure 2.1. Gasket 8 is located in a recess set into sealing plate 6 in the form of a chamfer and is pressed against the top edge of tubular housing 2 when screwed down by threaded ring 7, which produces the contact force on sealing plate 6 via a round shoulder 24. The force flux of the screwed connection thus proceeds from tubular housing 2 via threaded ring 7 to shoulder 24 and there presses down on sealing plate 6. Thermal expansions and deflections of sealing plate 6 are thus not introduced directly into the threaded connection.

[0031] A similar threaded connection between tubular housing 2 and housing bottom 1 is shown in detail in Figure 2.2. In this case, an O-ring gasket 10 is inserted into a groove 26 in housing bottom 1 resulting in a system that is convenient to assemble, and gasket 10 is maximally protected against shearing off or displacement during assembly.

[0032] A compressor housing according to the present invention is shown in perspective from the outside in Figure 3. In addition to the two pressure conduits 9 of the control valves on sealing plate 6, it is possible to see the mounting device produced by the two mounting ears 13 which are used to mount the compressor in a motor vehicle, for example. Sealing plate 6 is again screwed against tubular housing 2 by threaded ring 7. Mounting ears 27 may be seen on housing bottom 1 which, as

mentioned above, is also screwed onto tubular housing 2, the mounting ears being used to mount the compressor in the area of a belt drive using openings 28.

[0033] Another embodiment of a compressor housing according to the present invention is shown in Figure 4. Housing bottom 1 is again screwed to tubular housing 2 via a threaded connection. The housing cover is now represented by a pot-shaped cover 30 which is screwed to housing 2 and in doing so is clamped to and braced against tubular housing 2 via a clamping shoulder 31 of cylinder block 3. Cylinder block 3 is again sealed off from tubular housing 2 by a gasket device 5; another gasket device 8 seals the cylinder block off from housing cover 30. After cover 30 is screwed on, it presses cylinder head 4 and a valve plate 32 against cylinder block 3. Furthermore, cylinder head 4 contains an oil separator 40 already mentioned above. In addition, it is possible to see a pressure conduit 9 of a control valve projecting from housing cover 30, which according to the invention may be welded to cover 30, thus eliminating a gasket between the control valve and cover to the outside. In this case also, the elastic bottom of pot-shaped cover 30 is able to absorb thermal stresses within the cylinder head, so that these thermal stresses may be appropriately distributed and reduced on the top of the pot-shaped bottom and thus do not act directly on the threaded connection between tubular housing 2 and pot-shaped cover 30. Also the varying thermal expansions between cylinder head 4 preferably made from an aluminum material and a preferable steel material of cover 30 do not directly result in thermal stresses in the threaded area between tubular housing 2 and cover 30, but instead the stresses are appropriately absorbed by the elastic bottom of cover 30 and utilized for the pressing and sealing action of the cylinder head against the valve plate and against the housing cover.

[0034] The seal between this pot-shaped housing cover 30, tubular housing 2, and cylinder block 3 is shown in detail in Figure 5.1. The seal between cylinder block 3 and tubular housing 2 is accomplished by gasket 5 in a circumferential O-ring groove. The seal between cylinder block 3 and housing cover 30 is accomplished again by O-ring gasket 8 in a chamfer-like circumferential recess in cylinder block 3. When

housing cover 30 is screwed onto tubular housing 2, the cylinder block is clamped by its clamping shoulder 31 and gasket 8 is also appropriately pretensioned. Of course, one part of cover 30 must be supported directly on cylinder block 3 in order to apply the clamping forces for the clamping shoulder and not destroy gasket 8.

[0035] Sealing device 10 between housing bottom 1 and tubular housing 2 is shown in detail in Figure 5.2 and largely corresponds to the depiction in Figure 2.2, making any further explanation unnecessary.

[0036] In a simplified depiction, Figure 6 shows a compressor 100, the housing of which is made up of a pot-shaped housing part 102 and a housing sealing cover 103. A cylinder block 104 is located within housing 102, a valve plate 105 having suction and discharge valves being located on cylinder block 104. Valve plate 105 and cylinder block 104 are supported by spacers 106.1 and 106.2 on bottom 107 of pot-shaped housing part 102, which is made of one piece. Cylinder block 104 is attached to the housing bottom by fastening elements 108 located in the interior, such as screws, for example, which penetrate spacer 106.1 in the cylinder bottom as, for example, through pressure-tight openings 109. Spacer 106.2 separates discharge pressure zone 119 from drive area pressure zone 121, which is connected to drive area chamber 114 by a channel 122. In addition, the compressor has a drive shaft 110, which has a shaft bearing 111 and a shaft seal 112 within housing cover 103. A second shaft bearing 113 is located in the cylinder block. Within drive area 114, in which the drive mechanism of the compressor is located, there is a drive plate shown here in simplified form, such as a swash plate 115, which moves pistons back and forth in cylinder block 104 and thus converts the rotational movement of shaft 110 into a reciprocal movement of the pistons. It is of course also possible to use other drive mechanism systems such as swash plate mechanisms, pivot ring drives, etc. to drive the pistons. A gasket 116, which seals the gap between housing cover 103 and housing 102 to the outside, is located in the housing cover. This is the only seal of a point of separation of the housing to the outside which, in this case, is located on the cold side of the compressor, i.e., on the side of the compressor opposite the high

pressure side. Likewise, the mechanical connection between housing cover 103 and housing 102, for example, in the form of threads 117 in this case, is located on the cold side of the compressor. In the event of a failure due to high temperatures or high pressures, gasket 118 located on the hot side of the compressor within the housing, which in this case seals the cylinder block off from the closed housing, will not cause a loss of pressurized medium to the atmosphere. In contrast, gasket 116 sealing drive area 114 off from the environment is less exposed to thermal and compressive stress and therefore a longer service life may be expected in any case. Spacers 106.1 and 106.2, which separate the chambers for discharged coolant and aspirated coolant and drive area pressure, may be made up of a plurality of parts and may assume the sealing and insulating functions between hot high pressure zone 119 and cooler suction zone 120 as well as drive area pressure zone 121. To that end, spacers 106.1 and 106.2 and housing bottom 107 may, if necessary, contain a special thermoinsulation coating. Spacers 106.1 and 106.2 contain at least partially the intake and discharge chambers and this also may define a cylinder head.